Research Synopsis

A GIS Based Decision Support System for Identification of Artificial Water Recharge Site by Using Hydro-Geomorphic Approach.

Submitted By

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1. Introduction

Groundwater is a most precious natural resource with limited extent, which is essential for a human being for good health, economic growth and natural diversity. The increasing use of groundwater continuously due to the rapid growth of the population, accompanied by agricultural, municipal and industrial development. The annual withdrawal of groundwater happens to be generally distant (far) in excess of its net average natural recharge. It may be noted that not only its demand has increased over years, but it seems that the demand will never cease (end). The situation of groundwater in India, uncertainty in annual rainfall and imbalance between recharge and groundwater exploitation. A large amount of rainwater is lost through runoff, a problem compounded (arise) by the lack of rainwater harvesting practices. To protect this precious resource from overuse and contamination, it is necessary to implement groundwater recharge systems, such as farm ponds, check dams, percolation tanks, and Nala bonds, etc. [1].

The remote sensing and Geographic information system (GIS) tool can open new paths Water resource studies. Analysis of remote sensing data along the survey of India (SOI) topographical sheets and collateral information with necessary ground truth verification help in generating the baseline information for groundwater targeting. Identification of groundwater occurrence, location using remote sensing data is based on indirect analysis of directly observable terrain features like geological structures, geomorphology, and their hydrologic characteristics. Also, lineaments play a significant role in groundwater exploration in all types of terrain. Application of GIS and RS can also be considered for multi-criteria analysis in resource evaluation and hydrogeomorphological mapping for water resource management. A set of weights for the different themes are decided based on personal judgment, considering their relative importance from the artificial recharge viewpoint. These thematic layers can be integrated into a GIS framework to identify suitable zones for artificial recharge.

Integration of AHP with GA of Artificial Intelligence, which could be a useful geospatial tool for integrating multiple features/attributes that affect the artificial groundwater recharge process.

2. Literature Review

Saeed Rahimi, et al. [2] introduces an approach that integrates AHP with GA of Artificial Intelligence, which could be a useful geospatial tool for integrating multiple features/attributes that affect the artificial groundwater recharge process.

M. Mokarram, et al. [3] Artificial intelligence and machine learning methods can be used to automate the land suitability classification. Multiple Classifier System (MCS) or ensemble methods are rapidly growing and receiving a lot of attention and proved to be more accurate and robust than an excellent single classifier in many fields.

M N Ravi Shankar and G Mohan in [4] had identified the constructive zones for the application and adaptation of site-specific artificial-recharge techniques for expansion of groundwater through a Geographical Information System (GIS) based hydro geomorphic approach for identifying suitable zones for the adaptation of site using specific artificial recharge techniques for expansion of groundwater a satellite data from 1C LISS-III data was used for hydro geomorphological characteristics which had provided data about drainage pattern, DEM derived slope, lineament density, drainage density, and groundwater condition for the implementation of GIS analysis as criteria for the identification of suitable groundwater management plan.

Uday Kumar et al in [5] had a study on Groundwater Prospects Zonation Based on RS and GIS Using Fuzzy Algebra in Khoh River Watershed, Pauri-Garhwal District, Uttarakhand, India. (The groundwater prospect evaluation has been done which consist of thematic maps of geology, drainage, lineament and slope using LISS III satellite images.The use of thematic maps of geology, drainage, lineament, and the slope was done by the author with the help of LISS III satellite images for the groundwater potential mapping of the watershed region.

N. C. Gautam et al in [6] had investigated the GIS-based remote sensing data which had supported for decision making for convergent analysis of groundwater management. Author adopted a multi-disciplinary approach for the development of an inclusive tool which had supported for planning watershed development through artificial recharge of groundwater and rainwater harvesting. Throughout this study, the author had concluded

that the developed tool based on GIS platform was carried out for the identification of suitable sites for artificial recharge and rainwater harvesting.

In [1] water resource development plan was designed by Subah Raise and Akram Javed for Manchi basin in eastern Rajasthan (India) which was based on remote sensing and GIS. For the improvement of this plan, the whole basin was divided into 5 subbasins. Satellite data IRS P6 LISS-III (FCC) of 11th May 2012 was used for the preparation of land use/land cover and geomorphological map. During this investigation, the author analyzed morphometric parameters to be aware of the basin uniqueness and its persuade. The author performs Slope, geology and geomorphological mapping operations to delimit groundwater potential zones for futurity exploration. By employing GIS and remote sensing proficiencies, the author proposed drainage order which helped for suitable site selection for the construction of water harvesting structures, an attempt has been made by the author for best practicable water harvesting structures using GIS and remote sensing proficiencies which requires immediate measures to tap rainwater

I.P. Senanayake et al in [7] had studied GIS approach which was used to explain potential artificial recharge sites. In this scenario, the author had applied weighted linear combination method for identification of potential artificial recharge site for which they had used thematic maps such as rainfall, lineament, slope, drainage, land use/land cover, lithology, geomorphology and soil characteristics. The result of this study had shown that it has 49% of Ambalantota area which had variance in artificial recharging. For the improvement of groundwater resources percolation pits, recharge basins, recharge wells, ridges and furrows, check dams, gully control/stone wall structures, contour bunding, trenching and 17 land flooding Artificial recharging structures need to implement.

3. Research Outline

The research question, aims, objectives, significance, limitations, and justification are defined in this section.

3.1. Research Question

The research question examined by this research is:

"How does the GIS-based Decision Support System (DSS) using machine learning algorithms play role in the identification of artificial water recharge site? "

It is hypothesized that identification of artificial water recharge site by using decision support system can bring improvement in productivity and it could be achieved by using various factors like slope, lineament, soil, LULC, drainage density, geomorphology in GIS multi-criteria based decision support system.

3.2. Aim

The aim of this research is to develop GIS-based Decision Support System for identification of artificial water recharge site.

3.3. Objectives

The objectives of the study are as follows:

- To develop various thematic maps such as Soil map, Geomorphology map, Drainage density map, Lineament density map, Slope map and LULC map.
- To develop a Decision Support System for identification of hydro-geomorphic artificial recharge potential zone.
- Validate the approach through an applied case study using machine learning algorithm.

3.4. Significance

The major contribution of this research can be summarized as:

- It gives factual decision support system for identification of artificial water recharge site.
- Selection of thematic maps helps to understand non GIS experts with various complex factors. The spatial and statistical queries and analysis tool helps to make an analysis of present scenario.

4. Research Methodology:

The Development of research approach is applied in response to answering the research problem. The flow of the procedure for proposed study is as depicted in the figure.

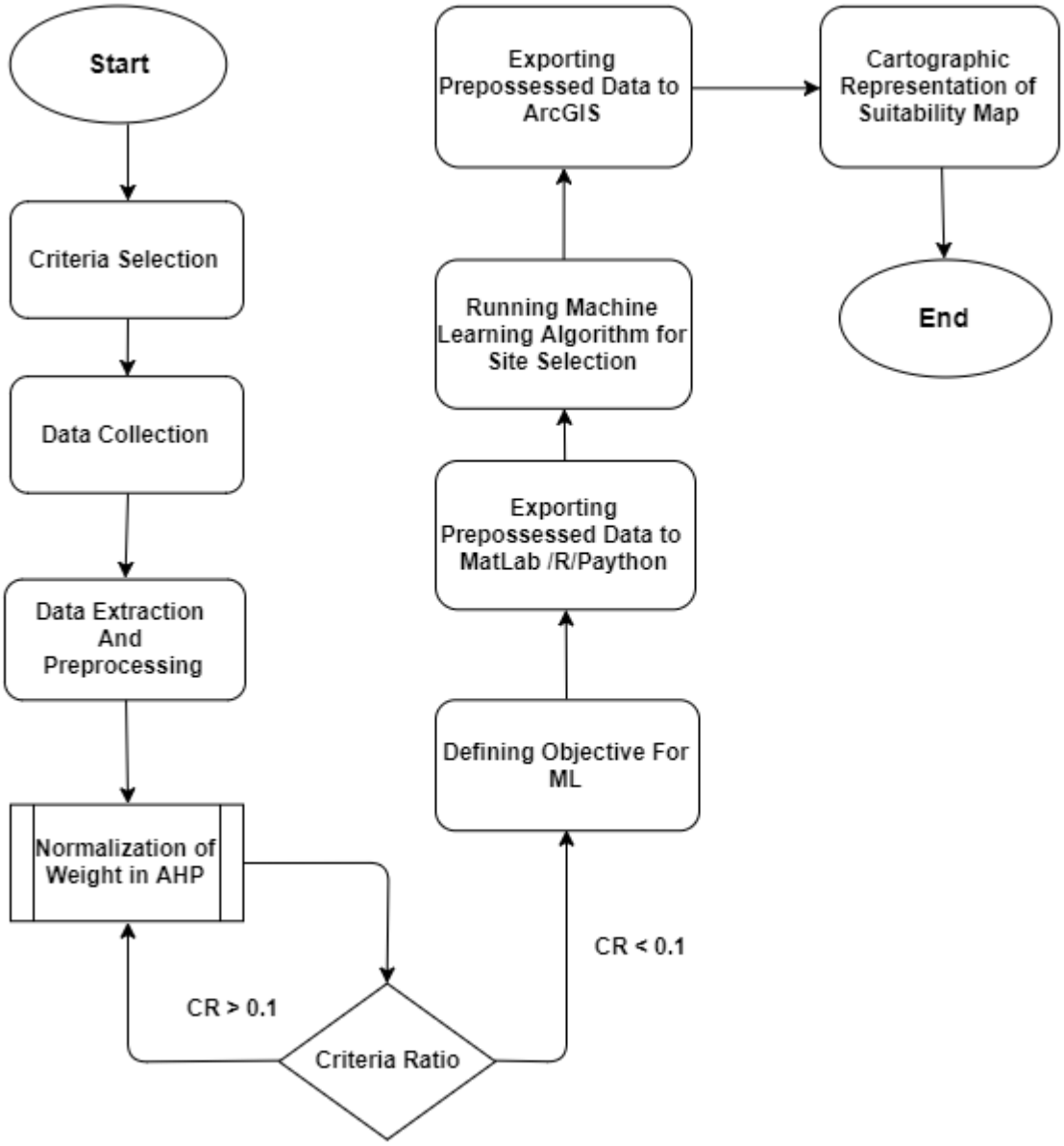

Fig. 1: Purposed Workflow for GIS-Based Decision Support System for Artificial Water Recharge Site Selection

5. Expected Outcome

Focused on the methodology, this study aims to use Geographic Information System (GIS) and Machine Learning Algorithm to mine knowledge from various data and integrate Hydrological expert knowledge to analyze and predict the Artificial Water Recharge Site Selection. The outcome from overall juncture lead to minor enhancements of the original theoretical outline and also provides new research question for future work.

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Research Guide

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